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University of Kentucky

POTATO FLEA-BEETLES

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BULLETIN NO. 297

(RESEARCH BULLETIN)

Potato Flea-Beetles

By H. H. JEWETT

The flea-beetles, *Epitrix fuscula* and *Epitrix cucumeris,* are of considerable economic importance in Kentucky because of their attacks upon potatoes. These beetles may be found feeding upon a considerable number of different kinds of plants, but they prefer, as hosts, members of the Solanaceous group such as potato, eggplant, pepper and tomato. *Epitrix fuscula* is sometimes referred to as the eggplant flea-beetle.

The potato flea-beetles begin collecting upon potatoes in early spring just as the plants are coming thru the soil and may be found upon them till cold weather in the fall. When two crops a year are grown, the preparation of the soil for the second crop helps keep the beetles in check, because the stirring of the soil disturbs and kills many of them in their immature stages.

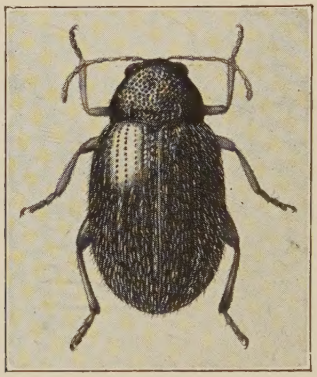
RELATIVE IMPORTANCE OF THE KINDS OF POTATO FLEA-BEETLES

In Kentucky, *Epitrix fuscula* is of more importance than *Epitrix cucumeris* as a pest of potatoes because it occurs in much larger numbers. *Epitrix cucumeris,* according to Professor H. Garman, has not been observed as a serious pest of potatoes in Kentucky. Besides these two flea-beetles, the tobacco flea-beetle, *Epitrix parvula* is generally present on potatoes but is less numerous than *Epitrix cucumeris.*

Relative number of flea-beetles collected in 1925

	May percent	June percent	July percent
E. fuscula	75	79	83
E. cucumeris	15	12	11
E. parvula	10	9	6

Collections in May, July and August, 1928, averaged for *E. fuscula,* 82 percent; *E. cucumeris,* 13 percent; and *E. parvula,* 5 percent.



The Potato Flea Beetle (Epitrix fuscula). Enlarged.

CHARACTER OF THE INJURY

The potato flea-beetles injure the leaves of both young and old plants by chewing out portions of the tissue, leaving them full of small holes. They attack all the leaves of the plant. The portions of the leaves surrounding the holes dry out and the leaves assume a rusty or browned appearance. Young plants are sometimes so severely injured that they are greatly weakened and their growth is checked. The larvae live in the soil and feed upon the roots and tubers and the parts of the stems which are in the soil. They feed upon the surfaces of the underground parts of the plants or bore into them, eating out tunnels of considerable length. The injured surface of the tubers becomes roughened, pitted or pimply, rendering them less attractive in appearance, so that buyers discriminate against them.

THE STAGES OF THE BEETLES

Egg. The eggs of *Epitrix fuscula* and *E. cucumeris* are eliptical in shape, white when first laid and slightly grayish when older. The surface of the chorion of the eggs of both beetles appears pitted or reticulated when examined with a microscope. Ten eggs of each species were measured. Those of *Epitrix fuscula* varied in length from .40 to .45 mm and in width from .21 mm to .23 mm. Those of *Eptirix cucumeris* varied in length from .44 mm to .50 mm and in width from .19 mm to .21 mm. The markings on the chorion of the eggs of the two species of beetles did not differ enough to make it possible to identify eggs as belonging to either beetle.

Larva. The larvae of both beetles are less than 1 mm in length when first hatched and when full grown vary from 3.5 to 4.5 mm in length. The larvae of both beetles are threadlike and delicate and each has three pairs of short thoracic legs and a pair of pro-legs on the last segment of the abdomen. The larvae of both beetles are white with light brown heads and reddish brown mouth parts. The thoracic shields of the specimens examined showed a very faint light brown color and sometimes the anal shields were slightly tinged with light brown.

Pupa. The pupae of both beetles are white when first formed and of about the same size as the adults. The general appearance of the pupae is that of other *Chrysomelids.*

Adult. Epitrix fuscula is ovate in shape, rather robust, convex and about 2 mm in length. The antennae are reddish-yellow, the femora black, and the tibiae and tarsi reddish yellow. The surface of the thorax is coarsely, deeply and densely punctured. The wing covers are striated, but the punctures are not so deep or coarse as on the thorax. The body is hairy and only slightly shiny.

Epitrix cucumeris is ovate in shape, black and shiny. It is less robust appearing than *E. fuscula* and slightly smaller, being 1.5 to 2 mm in length. The antennae and legs are reddish-yellow with the hind femora only, black. The surface of the thorax is more finely and sparsely punctured than is *E. fuscula*

and the wing covers are feebly striated. The body is covered with very fine hairs.

LIFE-HISTORY OF EPITRIX FUSCULA

Egg

Where Laid. The eggs are laid in the soil near the host plant, where the soil is shaded and moist, in small crevices or between particles of soil. Sometimes two or more are placed

The egg of Epitrix fuscula. Enlarged.

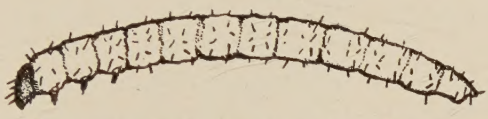
together. The depth at which the eggs are placed depends upon the mechanical condition of the soil. In loose soil, the beetles may work their way a half inch or more below the surface before laying their eggs.

Incubation Period. The average incubation period for eggs laid by overwintering adults was 6.5 days for 554 eggs laid on May 15 to June 1, 1925. The range of incubation periods for these eggs was 6 to 8 days. The average incubation period for eggs laid by first-brood adults was 6.1 days for 156 eggs laid on July 13 to July 18 in 1925. The range of incubation periods for the first-brood eggs was 6 to 7 days. The average incubation period for 208 eggs laid on July 13, 1927, was 5.8 days. The range of incubation periods was 5 to 7 days for the 208 eggs. These eggs were laid by adults which were collected from egg-plants in the field on July 12.

Larva

Habits. The newly hatched larvae in the laboratory wander about for a considerable distance and when placed on pieces of potato, roots or stems they begin feeding almost immediately. If the plant tissue is soft, the larvae soon bore into it. The habit of feeding beneath the surface of the soil makes it difficult to find them in the field. The larvae feed upon the roots and tubers and portion of the stalks below the surface of the soil.

A part of the feeding is done upon the surface of the tissues but much of it is done within the tissues by eating out small tunnels. The larva when full grown crawls out of the tissue and makes a small earthen cell within which it pupates.



The Larva of Epitrix fuscula. Enlarged.

Larval Period. The larva when full grown contracts and remains in this condition for a period of one to four days and then sheds its skin for the last time. The length of the larval period varies considerably. The average period was 24.7 days for 15 larvae of the first brood in 1925 and the range was 21 to 32 days. The average period for 12 larvae of the second brood in 1925 was 21.9 days and the range 20 to 24 days. The average period was 20.2 days for 23 larvae reared from eggs laid July 13, 1927, and the range, 17 to 22 days.

Larval Instars. The larval instars are difficult to determine, chiefly because the larvae are small and because they live within roots or tissues. The larval instars for eight larvae were determined in 1927. The eggs of these larvae were laid on July 13. The larvae molted three times, twice during their feeding period and once after they had completed the pupal cells. The first instar lasted for four days in all eight larvae, the second average instar was 9.5 days and the range, was 9 to 10 days, the third average instar was 7.1 days and the range, 5 to 8 days.

Pupa

Pupal Period. The pupa when first formed is about the size of the adult and is white, but at the time the adult is ready to emerge it is slightly darker. The pupae are found in the soil at depths ranging from one-fourth inch to three inches or more. When the larvae have formed their cells, many fail to pupate if they are disturbed. The pupal periods for 18 individuals of the first brood in 1925 ranged from 5 to 8 days with an average

of 6.3 days. The average pupal period for 12 individuals of the second brood in 1925 was 6.3 days and the range from 5 to

The pupa of Epitrix fuscula. Enlarged.

8 days. The pupal period was determined for 23 individuals in 1927. The average was 5.5 days and the range from 4 to 7 days.

Adult

Longevity. Overwintering adults may live about two months when kept on their host plants in cages. A lot of 258 beetles collected May 14, 1925, were all dead by July 7. A second lot of beetles collected in the field on May 9 and 10, 1928, were all dead by July 18. First-brood adults in 1925 lived in breeding cages from June 24 to August 15 and first-brood adults in 1928 lived in breeding cages from July 7 to September 12.

Habits. The adult is very light colored when it first emerges from the pupal case. It generally remains in the pupal cell for two or three days before it works its way to the surface of the soil and by that time its color is normal or nearly so. After feeding for a few days, mating takes place and egg-laying begins in about two weeks. The adults feed on both surfaces of the leaves but to a greater extent on the under surface. They generally eat small holes thru the leaves and sometimes nearly

skeletonize them. The beetles remain on the host plants or remnants of the plants till late fall when they go into hibernation.

Oviposition Periods. Overwintering adults in 1925 laid eggs in breeding cages from May 12 to June 20. This is a rather short period and it is very likely that beetles laid for a longer time in the field where conditions were more suitable for egg-laying. Beetles lived in the cages for more than two weeks after eggs were found for the last time. First-brood adults in 1925 began laying their eggs within three weeks after emergence from the pupae and in one lot of first-brood adults the oviposition period ranged from July 13 to August 8.

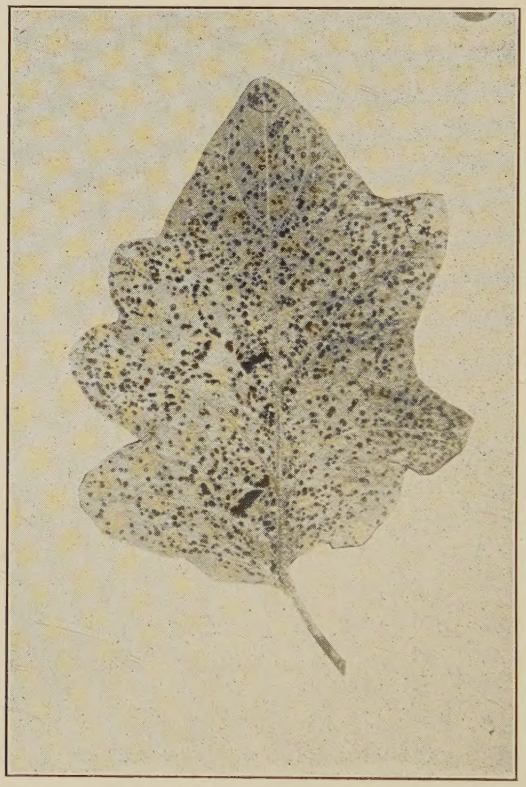
Overwintering adults in 1928 laid in breeding cages from May 14 to June 24 but some of the beetles lived till July 18. First-brood adults in 1928 began laying on July 9 and lived to August 17 in the breeding cages.

Cycle from Egg to Adult. The period of development from the laying of the egg to the appearance of the adult varies to some extent according to the time of the season. In the spring this period is a little longer than at mid-season. The average cycle for 155 individuals of the spring brood in 1925 was 40.6 days and the range was 32 to 46 days. The average cycle for 84 individuals of the second brood was 34.8 days and the range, 32 to 38 days. The average cycle for 23 rearings made from eggs laid on July 13, 1927, was 31.4 days and the range from 29 to 34 days. The average cycle was 44.7 days for 136 individuals of the spring brood in 1928 and the range 37 to 47 days. The average cycle was 30.9 days for 147 individuals of the second brood in 1928 and the range, from 29 to 37 days.

Number of Broods. During the seasons, 1925 and 1928, two broods appeared in the breeding cages. The first-brood adults began appearing on June 24, in 1925, and they commenced laying eggs for another brood on July 13. Second-brood adults began appearing on August 17, but no eggs were laid by this brood during the rest of the season.

First-brood adults began appearing on June 29 in 1928 and the first eggs for a second brood were laid on July 9. Second-

brood adults began appearing on August 9, but in the breeding cages no eggs or other stages of the beetles were found to indicate another brood.



Eggplant leaf showing characteristic injury by Epitrix fuscula. Leaf reduced to about one-half natural size.

The rearings of this beetle in cages indicate that there are two full broods a season, since early and late appearing first-brood adults mature and lay eggs the same season. There is some overlapping of broods which makes it impossible to separate them in the field at mid-season.

Hibernation. In the fall, after heavy frosts, the beetles collect under the vines or under litter in the field or on the edges

of the fields. The beetles are rather easily found at this time but later very few beetles can be found under the loose litter in the fields. The majority of the beetles enter the soil for hibernation before the ground freezes and come out early in the spring. It is very likely that the beetles that survive the winter are the ones that enter the soil for hibernation.

TABLES OF REARINGS

Table 1. Incubation Period of Eggs

First Brood	1925	No. of Eggs
Average	6.5 days	554
Range	6-8 days	
Second Brood	1925	No. of Eggs
Average	6.1 days	156
Range	6-7 days	
Second Brood	1927	No. of Eggs
Average	5.7 days	207
Range	5-7 days	

Table 2. First Brood, 1925

	Incubation Period of Eggs	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	6.2 days	24.7 days	6.1 days	37 days	15
Range	6-7 days	21-32 days	5-7 days	32-46 days	

Table 3. Second Brood, 1925

	Incubation Period of Eggs	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	6.3 days	21.9 days	6.3 days	34.6 days	12
Range	6-7 days	20-24 days	5-8 days	32-37 days	

Table 4. Second Brood, 1927

	Incubation Period of Eggs	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	5.7 days	20.2 days	5.5 days	31.4 days	23
Range	5-7 days	17-22 days	4-7 days	29-34 days	

Table 5. Development Period, Egg to Adult

Brood	First	Second	Second	First	Second
Date	1925	1925	1927	1928	1928
No. reared	155	84	23	136	147
Average	40.6	34.8	31.4	44.7	30.9
Range	32-46	32-38	29-34	37-47	29-37

Explanation of Tables

Table 1. The incubation periods in Table 1 are for eggs laid on the following dates: First brood, 1925, May 15, 16, 20, 21, 28, 29, and June 1; second brood, 1925, July 13 and July 16-18; second brood, 1927, July 13 by beetles collected July 12 and they are very likely second brood eggs.

Table 2. The eggs for these rearings were laid on May 5, May 28 and June 1. The first adults emerged on June 30 and the last on July 6. The table represents completed rearings.

Table 3. The eggs for these rearings were laid on July 16 to July 18. The adults appeared on August 17 to August 24. The table represents completed rearings.

Table 4. The eggs for these rearings were laid on July 13 and the adults emerged from August 12 to August 16. The table represents completed rearings.

Table 5. The period of development from the beginning of the egg stage to the appearance of the adult for several different rearings is summarized in this table.

EPITRIX CUCUMERIS

The life history and habits of this beetle are very similar to those of *E. fuscula*. The adults collect upon the potato plants at the same time in the spring, place their eggs in the same loca-

tion, attack the plants in a similar manner, and hibernate in a similar manner. The feeding habits of the larvae are identical with those of the larvae of *E. fuscula*. The adult of this species

The potato flea-beetle (Epitrix cucumeris). Enlarged.

is slightly more active than *E. fuscula* and is not so easily collected from the plants. *Epitrix cucumeris* was not so easily reared on eggplants as on potatoes, while *E. fuscula* could be reared equally well on eggplants as on potatoes.

The time required for the development of the different stages of *E. cucumeris* was practically identical with that of *E. fuscula* and there was the same number of generations a year.

Egg

Incubation Period. The average incubation period was 6.5 days for 321 eggs laid by overwintering adults in 1925 and the range was from 6 to 8 days. The average incubation period was 6.2 days for 145 eggs laid by first-brood adults in 1925 and the range was 5 to 7 days. The average incubation period was 8.3 days for 261 eggs laid by overwintering adults in 1928 and the range was from 7 to 10 days. The average incubation period was 6.3 days for 144 eggs laid by first-brood adults in 1928 and the range was from 6 to 7 days.

Larva

Larval Period. The larval periods were determined for 11 larvae of the spring brood in 1925. The average larval period for these was 21.7 days and the range was from 17 to 27 days. The larval instars were determined for three of the larvae. Each molted three times. The first two instars were of five days duration and the last eight days. The average larval period for 12 larvae of the second brood in 1925 was 19.7 days and the range from 18 to 22 days. The average larval period was 25.7 days for 13 first-brood larvae in 1928 and the range was from 22 to 28 days. The average larval period was 21.4 days for 16 second-brood larvae in 1928 and the range 20 to 25 days.

Pupa

Pupal Period. The pupae when newly transformed from the larvae are white but they become slightly darker when mature. They may be found in the soil at depths varying from one-half inch to 3 inches or more.

The pupal period for 11 pupae of the first brood in 1925 ranged from 5 to 7 days and averaged 6.1 days. The average pupal period for 12 pupae of the second brood in 1925 was 5.7 days and the range was from 5 to 7 days. The average pupal period was 8.8 days for 13 first-brood pupae in 1928 and the range was from 7 to 10 days. The pupal period for second-brood pupae in 1928 was somewhat shorter than for the first

brood. The average period from 16 pupae of this brood was 6.4 days and the range 5 to 8 days.

Adult

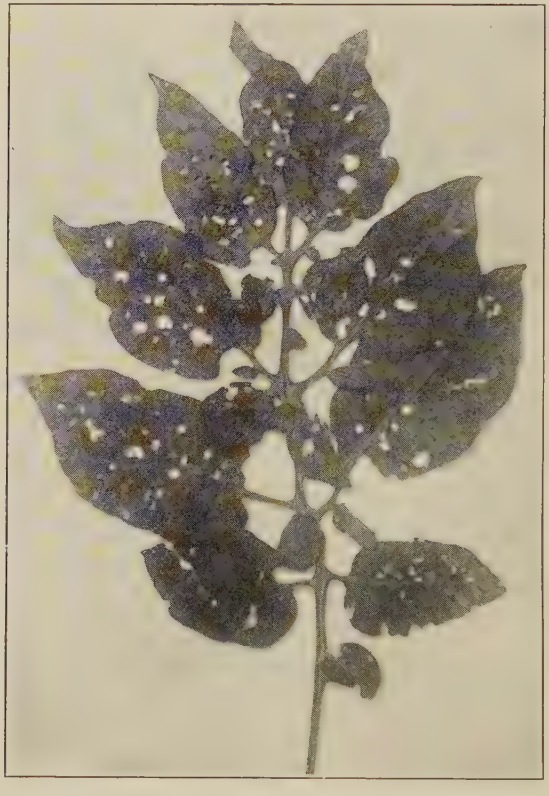
Longevity. Overwintering adults begin collecting on potato plants about May 1 and some of these live for two months or longer. Of a number of beetles collected May 14, 1925, a few lived till July 16 that season. Overwintering beetles in breeding cages in 1928 had all died by July 10. First-brood beetles which were collected from breeding cages on June 22 to June 23, 1925, were all dead by August 10 and first-brood adults collected from breeding cages on June 27, 1928, were all dead by July 17.

Oviposition Periods. Overwintering adults in breeding cages in 1925 laid eggs from May 14 to June 25, but some of the adults lived to July 16 in the cages. The complete oviposition period for the first-brood adults was not determined but adults collected from cages on June 22 and June 23 began laying on July 8 and continued to lay to July 24. A few of these adults were still alive on August 5. Overwintering adults in 1928 in cages began laying their eggs on May 9. The entire egg-laying period was not followed, but eggs were collected up to June 4. Some of the overwintering adults were present in cages till July 10. First-brood adults in 1928 began laying eggs on July 8 and continued to lay till the later part of August. Immature stages of the beetle were taken from soil in a cage in which adults were kept from August 24 to August 28 but no eggs or immature stages were found in the soil in cages in which adults were confined later than August 28.

Overwintering beetles commenced laying on May 5, 1929, and eggs were deposited till June 16 by one lot of beetles in a breeding cage. First-brood adults commenced laying in 1929 on June 26, but the oviposition period was not determined. The adults of the lot of beetles that commenced laying on June 26 were all dead by August 1.

Cycle from Egg Laying to the Adult. The average cycle was 36.5 days for 81 individuals of the first brood in 1925 and

the range in cycles was 30 to 41 days. The average cycle was 32.4 days for 121 individuals of the second brood in 1925 and the range in cycles was from 29 to 36 days. In 1928 the average



Potato leaf showing injury by Epitrix cucumeris.

cycle was 44.7 days for 157 individuals of the first brood and the range was from 40 to 53 days, while the average cycle was 32.2 days for 114 individuals of the second brood and the range was 32 to 38 days.

Number of Broods. Two broods develop during a season. The earliest first-brood adults appeared on June 19, 1925, and on June 21, 1928. The earliest second-brood adults appeared on

August 10, 1925, and on August 14, 1928. No eggs were laid for a third brood.

TABLES OF REARINGS

Table 6.—Incubation Period of Egg

First Brood	1925	No. of Eggs
Average	6.5 days	
Range	6-8 days	321
Second Brood	1925	No. of Eggs
Average	6.2 days	
Range	5-7 days	145
First Brood	1928	No. of Eggs
Average	8.3 days	
Range	7-10 days	261
Second Brood	1928	No. of Eggs
Average	6.3 days	
Range	6-7 days	144

Table 7.—First Brood 1925

	Incubation Period of Egg	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	6.5 days	21.7 days	6.1 days	34.3 days	11
Range	6-7 days	17-27 days	5-7 days	29-40 days	

Table 8.—Second Brood 1925

	Incubation Period of Egg	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	6.2 days	19.7 days	5.7 days	31.5 days	12
Range	6.7 days	18-22 days	5-7 days	30-33 days	

Table 9.—First Brood 1928

	Incubation Period of Egg	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	8.4 days	25.7 days	8.8 days	42.8 days	13
Range	7-10 days	22-28 days	7-10 days	40-47 days	

Table 10.—Second Brood 1928

	Incubation Period of Egg	Larval Period	Pupal Period	Egg to Adult	Number Reared
Average	6.5 days	21.4 days	6.4 days	34.2 days	16
Range	6-7 days	20-25 days	5-8 days	32-38 days	

Table 11.—Development Period, Egg to Adult

Brood	First	Second	First	Second
Date	1925	1925	1928	1928
No. Reared	81	121	157	114
Average	36.5 days	31.9 days	44.7 days	32.2 days
Range	30-41 days	29-36 days	40 53 days	32-38 days

Explanation of the Tables

Table 6. This table represents incubation periods of eggs laid on the following dates: First brood, 1925, May 14 and 15, 20 and 21, 28 and 29, June 1 and 8; second brood, 1925, July 8, 10, 13, 17, 21 and 24; first brood, 1928, May 11 to 14, 21 to 25 and 30; second brood, 1928, July 9 and 10, 14 and 15, 20, 22, 28, 30.

Table 7. The eggs for the rearings represented by this table were laid on May 14 and 15, 28 and 29 and June 25.

Table 8. The eggs for the rearings represented by this table were laid on July 10, 13 and 17.

Table 9. The eggs for the rearings represented by this table were laid on May 11 to 14.

Table 10. The eggs for the rearings represented by this table were laid on July 10, 14 and 15.

Table 11. This table represents the period of development from the beginning of the egg stage to the appearance of the adult for a number of individuals of different broods. The first-brood rearings in 1925, as given in the table, were made from eggs laid on May 14 to 25; the second-brood rearings in 1925 were made from eggs laid on July 8 to 24. The first-brood rearings in 1928, as given in the table, were made from eggs laid

on May 11 to 25; the second-brood rearings in 1928 were made from eggs laid on July 9 to 30.

SUMMARY

The two flea-beetles, *Epitrix fuscula* and *Epitrix cucumeris*, attack potatoes in Kentucky but *E. fuscula* is much more numerous than *E. cucumeris*.

The beetles collect on the vines at about May 1 when the plants are just coming thru the soil and may be found on them till cold weather in the fall.

The time that elapses from the time the egg is laid to the appearance of the adult is practically identical for the two beetles. This period is generally from 30 to 45 days.

Two broods developed during the seasons of 1925 and 1928, but there is some overlapping of broods at mid-season.

The beetles generally crawl under litter in the fields in the fall and later enter the soil to hibernate.

REARING METHODS

Rearing potato flea-beetles is rather difficult, because of their small size and because the development of the immature stages takes place in the soil or in the underground parts of the host plant.

Eggs were secured by confining the adults in lantern globes covered at both ends with organdy or similar cloth and then placed upon dark paper upon moist soil. The beetles place many of the eggs on the paper from which they can be easily collected. At other times eggs were secured by examining the soil in cages in which a large number of beetles were confined.

After the eggs were collected, they were placed upon pieces of moist blotting paper in small dishes and when the eggs hatched the incubation periods were recorded.

The larvae were raised by placing them as they hatched upon small pieces of potato, stems or roots. When full grown, they were given moist soil into which they entered to pupate.

The pupae were collected from the soil and were placed in dishes until the adults appeared.

The complete cycle from the beginning of the egg stage to the adult stage was determined in many cases by confining beetles in cages over potted potatoes for daily periods and later recording the emergence of the adults.

SUGGESTIONS FOR CONTROL

Potato flea-beetles are difficult to control because they do not readily eat leaves that have been treated with insecticides. The arsenical sprays are effective in killing many of the beetles. The arsenical sprays and Bordeaux mixture act to a considerable degree as repellants.

The plants should be sprayed as soon as the beetles begin collecting on them. Lead arsenate may be used at the rate of 4 pounds in 100 gallons of water or calcium arsenate at the rate of 3 pounds in 100 gallons of water. If the beetles are not controlled by a single spraying, a second spraying should be made 10 days after the first. When Bordeaux mixture is used for controlling diseases, the arsenicals mentioned should be used in the mixture in the same proportion recommended for use in water.

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